

# National Prevalence and Exposure Risk for Cockroach Allergen in U.S. Households

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We characterized the prevalence of cockroach allergen exposure in a nationally representative sample of U.S. homes and assessed risk factors for elevated concentrations.

**DESIGN:** We used data from the National Survey of Lead and Allergens in Housing, a population-based cross-sectional survey.

**PARTICIPANTS:** Participants were residents of 831 U.S. homes in the survey.

**EVALUATIONS/MEASUREMENTS:** We analyzed allergen, questionnaire, and observational data of 831 U.S. homes.

**RESULTS:** Cockroach allergen (Bla g 1) concentrations exceed 2.0 U/g, a level associated with allergic sensitization, in 11% of U.S. living room floors and 13% of kitchen floors. Concentrations exceed 8.0 U/g, a level associated with asthma morbidity, in 3% of living room floors and 10% of kitchen floors. Elevated concentrations were observed in high-rise apartments, urban settings, pre-1940 constructions, and households with incomes < \$20,000. Odds of having concentrations > 8.0 U/g were greatest when roach problems were reported or observed and increased with the number of cockroaches observed and with indications of recent cockroach activity.

**CONCLUSIONS:** Household cockroach allergen exposure is characterized in a nationally representative context. The allergen is prevalent in many settings, at levels that may contribute to allergic sensitization and asthma morbidity.

**RELEVANCE TO CLINICAL OR PROFESSIONAL PRACTICE:** Likelihood of exposure can be assessed by consideration of demographic and household determinants.

**KEY WORDS:** allergens, asthma, Bla g 1, cockroach allergen. *Environ Health Perspect* 114:522–526 (2006). doi:10.1289/ehp.8561 available via <http://dx.doi.org/> [Online 15 November 2005]

Asthma, a chronic respiratory disease characterized by episodes of airway inflammation and narrowing, represents a significant public health problem. The prevalence of asthma in the United States has increased considerably since 1980 (Mannino et al. 1998), coinciding with an increasing tendency among Americans to spend time indoors [U.S. Environmental Protection Agency (EPA) 1996]. These patterns have led researchers to carefully examine exposure to indoor allergens as an important risk factor for asthma.

It has been clearly established that exposure to cockroach allergen is one such risk factor. Many studies have demonstrated this association, including some that have found that levels of cockroach allergen in homes are one of the strongest risk factors predictive of allergic sensitization and asthma morbidity in children (Arruda et al. 2001; Call et al. 1992; Chapman et al. 1996; Crain et al. 2002; Eggleston et al. 1998; Gelber et al. 1993; Rosenstreich et al. 1997; Sarpong et al. 1997). It has been estimated that 26.1% of the U.S. population exhibits allergic sensitization to the German cockroach, based on rates of positive skin tests from the Third National Health and Nutrition Examination Survey (NHANES III) (Arbes et al. 2005a). However, estimates of exposure in a nationally representative sample of homes have never been reported.

Previous studies examining levels of cockroach allergens and associated characteristics in U.S. homes have targeted specific populations such as single metropolitan areas and inner-city neighborhoods (Chew et al. 1998; Gehring et al. 2004; Kitch et al. 2000; Leaderer et al. 2002). Such studies are critical for identifying important relationships in high-risk populations but do not permit a more general understanding of allergen exposure. For example, a major study of the homes of asthmatic children demonstrated key exposure–disease relationships but involved a nonrandom sample that exhibited wide variation in cockroach allergen levels between various metropolitan areas (Huss et al. 2001). Nationally representative data are needed to provide a broadly applicable characterization of household cockroach allergen levels and their determinants. For this article, we took such data from the National Survey of Lead and Allergens in Housing (NSLAH), conducted from 1998 through 1999 by the National Institute of Environmental Health Sciences (NIEHS) and the U.S. Department of Housing and Urban Development (Jacobs et al. 2002; Vojta et al. 2002).

The weighted NSLAH population is, by design, comparable with the U.S. population of eligible housing units: 28% in urban areas with population > 1 million, 39% with children < 18 years of age, 80% white, 8% Hispanic, and 80% above the poverty level.

The objectives of this research are to provide the first nationally representative estimates of cockroach allergen prevalence within households and to identify demographic factors and housing characteristics associated with high cockroach allergen levels. Achieving these objectives will provide a characterization of household cockroach allergen exposure on a nationwide basis, assist clinicians in assessing the likelihood of a patient's exposure, and influence research hypotheses for intervention studies.

## Materials and Methods

The NSLAH was a cross-sectional survey of the U.S. population of 96 million permanently occupied, noninstitutional housing units that permit resident children, and was carried out in 1998–1999. A complex, multi-stage design was used to sample and gain participation from 831 housing units containing 2,456 individuals. The staged design involved the selection of 75 primary sampling units (defined as metropolitan statistical areas or counties) across the United States, followed by the sampling of segments (defined as contiguous blocks) within each primary sampling unit, and then the sampling of housing units within each segment. Among 1,984 housing units initially selected to be recruited into the study, 980 were determined to be eligible during screening, 229 were found to be ineligible, and 775 did not complete sufficient screening to determine eligibility. Assuming that the eligibility rate among these 775 is the same as the rate among households of known eligibility, the surveyed population of 831 housing units constitutes a response rate of 52% of an estimated 1,608 eligible units. Demographic

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